Assignment 7.4 Questions 3, 4, 5, 6, 8, 12, 85 – 101 odd, 123, 124, 135

3) Both are definitely alkaline earth metals because it is easy to remove 2 electrons, but requires a lot more energy to remove the third. Since X has lower ionization energies than Y, it must be further down on the periodic table.

The ratio of the first ionization energies Y/X = 200/170 = 1.176

The only alkaline earth metals with the same ratio are ***Ca and Ba*** (590/503 = 1.173)

4) Helium already has the highest first ionization energy because it is so small. The second ionization energy is even higher because after losing one electron, the remaining electron is no longer repelled by the first electron.

5) Lithium has the higher second ionization energy. Beryllium has 2 valence electrons, so it easier to remove them. If lithium loses a second electron, it has to come from the first energy level, which is very close to the nucleus.

6) The exceptions occur (a) when starting the p-sublevel and (b) sometimes when beginning a new half-sublevel.
(a) Elements ending with p^1 require less energy to remove one electron than the element before them (ending with s^2) because there is only one electron to be removed from that sublevel.
(b) Oxygen requires less energy to remove one electron than nitrogen because nitrogen has half-filled p-orbitals, which is more stable.

8) Metals are elements that tend to lose electrons. The further down the periodic table, the more energy levels the element has, and therefor the larger the atom. The farther an electron is from the nucleus, the easier it is to remove electrons. Example: Carbon and lead both have 4 valence electrons. Carbon's valence electrons are held closely to the nucleus, so it holds them more tightly, thus carbon acts like a nonmetal. Lead's valence electrons are farther from the nucleus, so it is easier to remove them, thus lead acts like a metal.

12) Going down the periodic table the ionization energy decreases because the valence electrons are farther from the nucleus, thus it is easier to remove them.

85) a. S (smallest), Se, Te (largest) *more energy levels = larger atom*
b. Br (smallest), Ni, K (largest) *more protons = greater pull on electrons*
c. F (smallest), Si, Ba (largest) *both trends apply*

87) a. S (highest), Se, Te (lowest)
b. Br (highest), Ni, K (lowest)
c. F (highest), Si, Ba (lowest)

The larger the atom, the farther away its valence electrons are from the nucleus and therefore the lower the first ionization energy.

89) a. He (the second proton creates a greater pull on the electrons)
b. Cl (both trends apply)
c. Element 117 (both trends apply)
d. Si (both trends apply)
e. Na^+ (by losing an electron, sodium no longer has a 3rd energy level)

91) Sg - [Rn] $7s^2\ 5f^{14}\ 6d^4$

93) Arsenic has a slightly higher first ionization energy because it has half-filled p-orbitals, which is slightly more stable.

95) a. Electron affinities are exothermic if adding one electron makes the atom more stable. Carbon and bromine have greater electron affinities. Nitrogen does not become more stable by gaining one electron because it would occupy an orbital already containing an electron). Argon does not become more stable because an extra electron would start a whole new energy level, which is less stable.

b. Nitrogen and argon have greater ionization energies.

c. Carbon and bromine have larger size.

97) The electron affinities increase (more exothermic) going from left to right. The more protons, the greater the attraction for electrons to fill the sublevel. The exception is phosphorus (for the same reason as #95a above.)

99) a. I (least), Br, F, Cl (most exothermic) - Cl over F is an exception to the trend
b. N (least), O, F (most exothermic)

101) a. $Se^{3+} \longrightarrow Se^{4+} + e^-$
b. $S^- + e^- \longrightarrow S^{2-}$
c. $Fe^{3+} + e^- \longrightarrow Fe^{2+}$
d. $Mg \longrightarrow Mg^+ + e^-$

123) This is most likely an alkaline earth metal because it is a lot easier to remove the first two electrons than the third. It clearly has 2 valence electrons.

124) a. 6 valence electrons
b. oxygen, sulfur, selenium, or tellurium
c. K_2X
d. It would have a much smaller radius than barium
e. It would have a smaller ionization energy than fluorine

135) a. It requires more and more energy to remove each subsequent electron.
b. Al has 3 valence electrons so it is much easier to remove them than the 4th electron, which is a core electron.
c. Al^{4+} has the greatest electron affinity. 11,600kJ/mol would be released by gaining one electron.
d. Al (largest) > Al^+ > Al^{2+} > Al^{3+} > Al^{4+} (smallest)
The more electrons, the larger the size.